



Nevada Department of Health and Human Services
Nevada State Health Division (NSHD)
HAI Prevention Conference, 2009

Fundamental Principles of Infection Prevention or "Doctor, is that an MRSA on your stethoscope?"

Insights into Prevention & Control of Multidrug-resistant Organisms (MDROs)

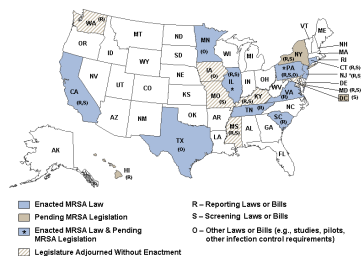
Russell N. Olmsted, MPH, CIC
Epidemiologist, Infection Control Services, SJMHS – Ann Arbor
olmstedR@trinity-health.org

Agenda

- Describe the epidemiology of multidrug-resistant organisms (MDROs)
- Describe the epidemiology of Clostridium difficile infection (CDI) in U.S. healthcare facilities
- List at least one finding from investigations of the role of the environment in cross transmission of MDROs and CDI
- Distinguish efficacy of various strategies to prevention cross transmission of MDROs and CDI
- Describe at least one intervention to prevention and control MDROs and CDI

External factors: MRSA Mandates

MRSA Laws & Pending Legislation



Copyright 2009 – Association for Professionals in Infection Control and Epidemiology, Inc.
Please contact communications@apic.org for reprint permission and update requests.
Last updated 5/20/2009

New Nevada-Specific Legislation

Senate Bill No. 325–Senator Cegavske

CHAPTER.....

- "...authorizing hospitals to establish a program concerning methicillin-resistant Staphylococcus aureus (MRSA); encouraging the Nevada Hospital Association to develop a method to collect information concerning such infections; and providing other matters properly relating thereto.
- Effective 10/01/2009

Institute for Healthcare Improvement



New Interventions:

- Prevent Harm from High-Alert Medications
- Reduce Surgical Complications
- Prevent Pressure Ulcers
- Reduce MRSA Infection
- Evidence-based care of CHF
- Improving effectiveness of Boards of Directors

IHI MRSA Reduction Initiative

- Hand Hygiene
- Decontamination of the environment and equipment
- Active surveillance cultures (ASC)
- Contact precautions for infected and colonized
- Comply with CLABSI & VAP prevention bundles
 - Pronovost P, et al. N Engl J Med. 2006;355(26):2725-32.

•MHA Keystone Has Done or Is Already Underway

The Joint Commission

External factors,
continued

National Patient Safety Goals, Hospital, 2009

NPSG.07.03.01

- Implement evidence-based practices to prevent health care-associated infections due to MDROs in acute care hospitals.
 - Note 1: This requirement applies to, but is not limited to, epidemiologically important organisms such as MRSA, Clostridium difficile (CDI), VRE, and MDR gram negative bacteria.
 - Note 2: One-year phase-in period - planning, development, and testing (milestones) at 3, 6, 9 months in 2009, with the expectation of full implementation by January 1, 2010.

MI Quality Improvement Organization MRSA Project, August 2008

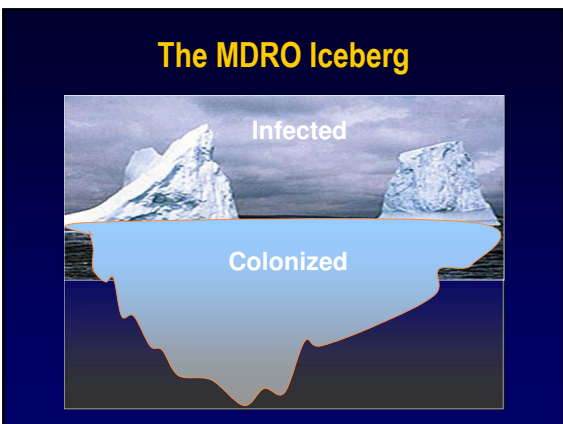
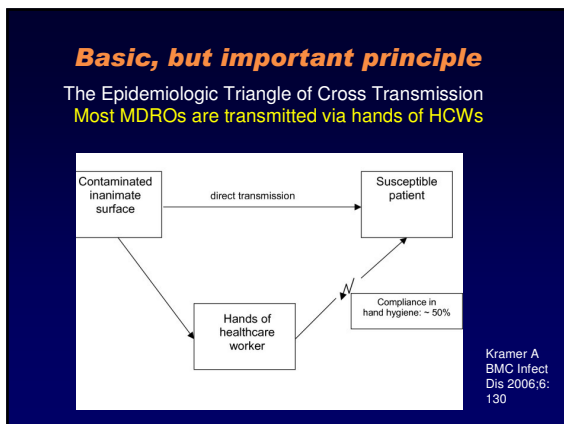
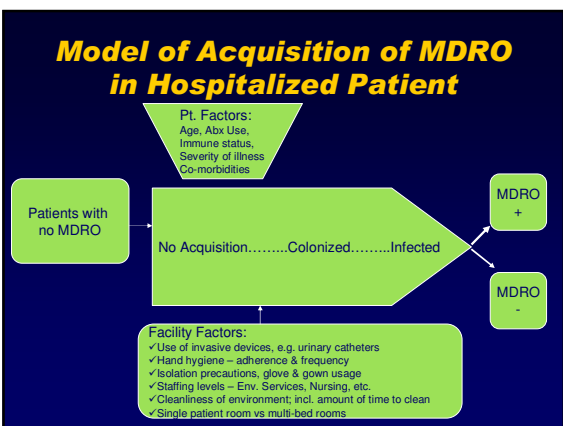
CMS Sponsored 9th Scope of Work

Goal: Reduce incidence of HAIs caused by MRSA

Recruitment period – September 2009

The Usual Suspects

- Vancomycin-resistant enterococci (VRE)¹
- Methicillin-resistant *S. aureus* (MRSA)²
- Clostridium difficile*³
- Acinetobacter baumannii*⁴



MRSA Makes The Headlines

- Number of cases of serious MRSA infection, 2005 = 94,360
- Mortality = 18,650 cases
- Predominantly related to exposures to healthcare delivery:
 - 85% associated with healthcare
 - 2/3 occurred outside of the hospital;
 - 1/3 during hospitalization

Invasive Methicillin-Resistant *Staphylococcus aureus* Infections in the United States

Klebens RM, et al. JAMA 2007;298:1763-71.

Late breaker -

FOR IMMEDIATE RELEASE -
October 26, 2007
MDCH Issues Guidance To
Communities On MRSA
- No need to close & disinfect
entire school system

Brief Segue

- Can you give MRSA to a pig?
- Yes, we all know about lipstick and swine but....

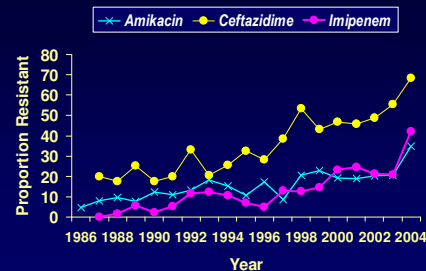
Methicillin-Resistant *Staphylococcus aureus* ST398 in Swine Farm Personnel, Belgium

Olivier Denis, Carl Suetens, Marie Hallin, Boudevijn Catry, Ilse Ramboer, Marc Diaspas, Glenda Willems, Bart Gordts, Patrick Butaye, and Marc J. Struelens

Identified Risk Factor!



Antimicrobial Resistance among *Acinetobacter* sp., From ICUs 1986-2003*



*Source: NNIS System

Squeezing the Balloon

- "Infection Control programs that focus on one organism or only one antimicrobial agent are unlikely to succeed."
- Safdar N, Maki DG. Ann Intern Med 2002



MRSA

ESBL + gram neg.
P. aeruginosa;
A. Baumannii ;
Carbapenemase producing *K. pneumoniae* (KPC)

As Yogi says, "It's déjà vu all over again"; More gram-negatives to worry about

MMWR

Guidance for Control of Infections with Carbapenem-Resistant or Carbapenemase-Producing *Enterobacteriaceae* in Acute Care Facilities

March 20, 2009 / Vol. 58 / No. 10

- 1st reported in 1999 from patients in North Carolina
- Prevalence of carbapenem-resistant *Klebsiella pneumoniae* has increased to 8% of all *Klebsiella* spp. NHSN data, from 1% in 2000

Perspective on MDROs relative to other potential pathogens

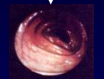
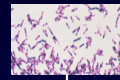
Some bad pathogens in healthcare really are not multi-drug resistant:

- methicillin susceptible *S. aureus* (MSSA)
- Group A Streptococcus
- *Clostridium difficile*

Strategies described to control MDROs are often applied to control epidemiologically important organisms other than MDROs.

Clostridium difficile

- Anaerobic spore-forming bacillus
- Pseudomembranous colitis, toxic megacolon, sepsis, and death
- Fecal-oral transmission through contaminated environment and hands of healthcare personnel
- Antimicrobial exposure is major risk factor for disease



Healthy colon

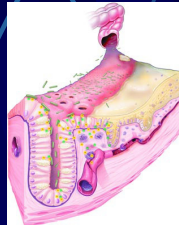


Pseudo-membranous colitis

Pathogenesis of *C. difficile* Infection (CDI)

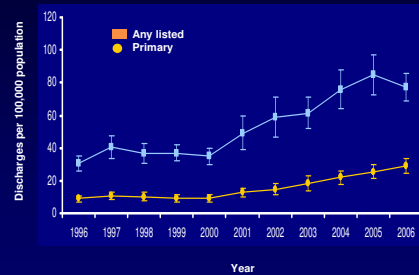


Ingestion
Germination
Proliferation
Toxin Production



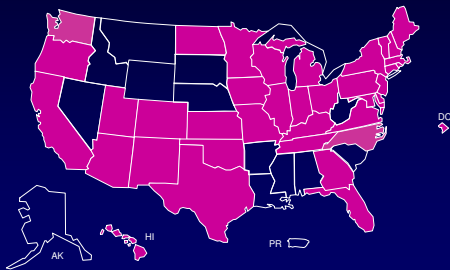
Sunersingh RH, McDonald LC, *Cleve Clin J Med*. 2006;73:1987-1997, with permission.

National Estimates of US Short-Stay Hospital Discharges with *C. difficile* as First-Listed or Any Diagnosis

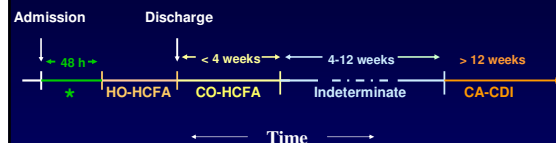


From McDonald LC, et al. *Emerg Infect Dis*. 2006;12(3):409-15 and unpublished CDC data

States with BI/NAP1/027 Strain of *C. difficile* (N=38), November, 2007



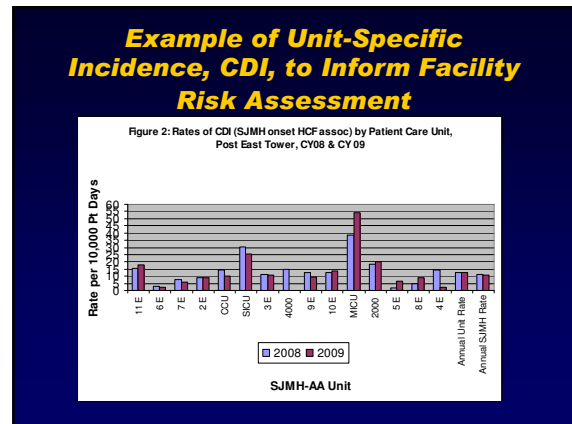
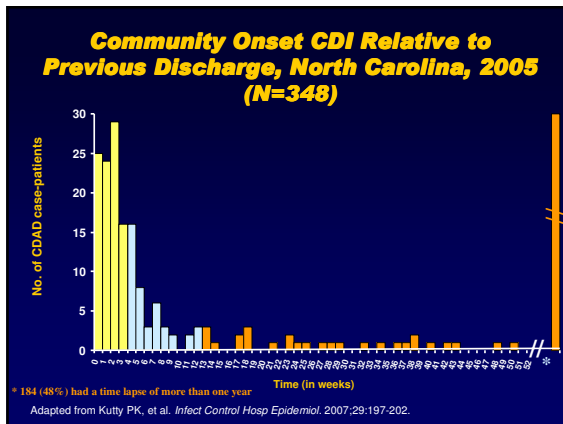
Recommendations for Surveillance of *Clostridium difficile* Infection



HO: Hospital (Healthcare) onset
CO-HA: Community Onset Healthcare-associated
CA: Community Associated

* Depending upon whether patient was discharged within previous 4 weeks, CO-HA vs. CA

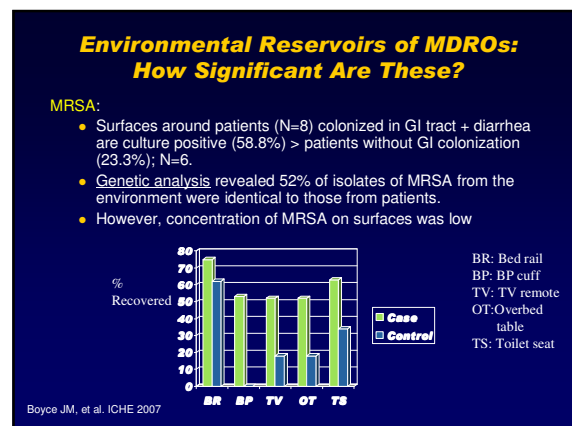
CDAD Surveillance Working Group. *Infect Control Hosp Epidemiol* 2007; 28:140-145



Survival of Select Microbes on Environmental Surfaces

Microorganism	Duration of Survival
<i>Acinetobacter</i> spp.	3 days – 5 months
<i>Clostridium difficile</i>	5 months – 1 yr ?; spore 15 min – 3 hrs: vegetative form
<i>Enterococci</i> (incl. VRE)	5 days – 4 months
<i>Serratia marcescens</i>	3 days – 2 months; dry floor = 5 weeks
<i>Staphylococcus aureus</i> (incl. MRSA)	7 days – 7 months
Hepatitis B virus (HBV)	≥ 1 week
Human immunodeficiency virus (HIV)	3-4 days
Norovirus	8 hrs – 7 days

Kramer A. BMC ID 2006; McFarland L, et al. AJIC 2007



Environmental Surfaces, cont.

Who's Been in the Room Before or With You?

- Huang SS (2006): 8 adult ICUs. Admission to room previously occupied by patient with MRSA or VRE = increased risk of acquiring MRSA or VRE.
- Drees M (2008): 2 ICUs. 50/638 (8%) patients admitted acquired VRE. Higher risk if room was culture + previously, if prior patient (as much as 2 weeks) had VRE

Environment, cont.

Who's Been in the Room Before or With You?

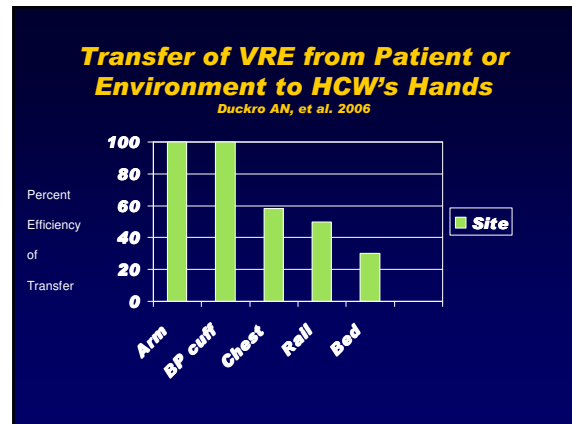
- Zhou Q (2008): 472 bed acute care hospital. 8/88 (21%) roommates of patients colonized or infected with VRE acquired VRE.
- Moore C (2008): 472 bed acute care hospital. 25/198 (13%) roommates of patients colonized or infected with MRSA acquired this organism vs 3% of roommates of patients negative for MRSA.

The Inanimate Environment Can Facilitate Transmission

X represents VRE culture positive sites

~ Contaminated surfaces increase cross-transmission ~

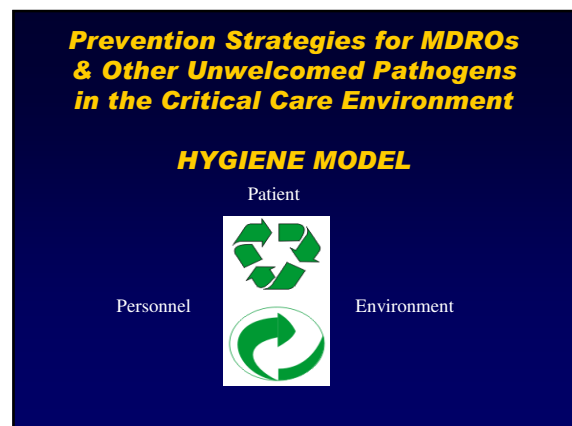
Duckro AN, et al. Transfer of vancomycin-resistant enterococci via health care worker hands. Arch Intern Med 2005;165:302-7.



Clostridium difficile & the Environment

- 6 Hospitals, St. Louis Metropolitan area studied for persistence of *C. difficile* in patient care areas
- 13/48 samples were + for *C. difficile*; more likely in rooms of patients with *C. difficile* infection (CDI)
- "Hot zones" more likely contaminated = toilet and commode; no detection of *C. difficile* outside patient room, e.g. nurses station.
- 4/6 hospitals used bleach solution for rooms of patients with CDI and QAC for all others

Dubberke ER. AJIC 2007; 35:315-8.



Systematic Approach – Preventing Cross Transmission of All Pathogens

Efficacy of Hand Hygiene Preparations in Killing Bacteria

Hand Hygiene for Healthcare Personnel

Good Better Best

Plain Soap Antimicrobial soap Alcohol-based handrub

Brief Segue: Principles of Cross Transmission of Pathogens in Healthcare Facilities -

- Panel A (left): Culture of healthcare worker's hand following ungloved abdominal exam of a patient with spinal cord injury – colonized in nares with methicillin-resistant *S. aureus* (MRSA)
- Panel B (right): Same worker's hand after application of alcohol-based handrub (ABHR)

Donskey CJ, et al. N Engl J Med 2009;360:e3

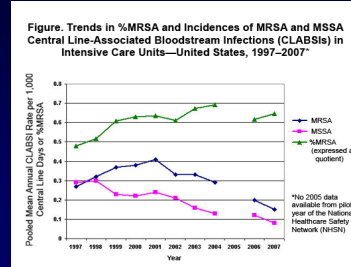
On the other hand...Be a critical thinker when you read:

- Hospital scrubs are a deadly, germy mess – B. McCaughey, Wall St J 01/08/09:A13
- Instead the Evidence-based Reality is:
 - “The hypothesis that uniforms/clothing could be a vehicle for the transmission of infections is not supported by existing evidence.”
- Wilson JA, et al. Uniform: an evidence review of the microbiological significance of uniforms and uniform policy in the prevention and control of healthcare-associated infections. J Hosp Infect 2007; 66, 301-7.



Pathogen Specific Analysis: MRSA & CLABSI; good & the bad

- NNIS & NHSN data, CDC
- CLABSIs - ICU
- % of BSI caused by MRSA increased from 47.9 to 64.7
- However: incidence of BSI from both MRSA decreased by 44.4% since 2001



Burton DC, JAMA 2009 Feb 18;301(7):727-36

MAJOR ARTICLE

Vancomycin-Resistant *Staphylococcus aureus* in the United States, 2002–2006

Dawn M. Sievert,^{1,2} James T. Rudrik,^{1,2} Jean B. Patel,¹ L. Clifford McDonald,¹ Mailenda J. Wilkins,¹ and Jeffrey C. Hargrett¹

¹Michigan Department of Community Health, Lansing; and ²Centers for Disease Control and Prevention, Atlanta, Georgia

9 Cases reported in the U.S., 2002–07:

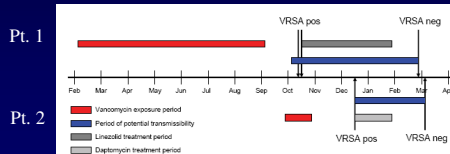
- Seven (78%) were reported from Michigan
- All history of prior inf. or colonization with MRSA & Enterococci
- The good news: no secondary transmission to other family mem healthcare personnel, or other contacts

Clin Infect Dis 2008;46 (March 1) + updated report: Finks J, et al. Emerg Infect Dis 2009

Timeline on Emergence of VRSA

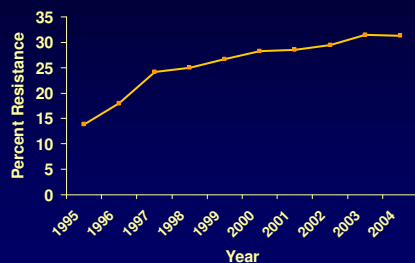
Patient 1: R plantar foot wound. Risk factors: IDDM, chronic foot ulcer, prior + MRSA, VRE. Abx = vanco. + ceftriaxone for 7 months

Patient 2: L plantar foot wound. RFs: IDDM. Abx= vanco + levo. 4 weeks

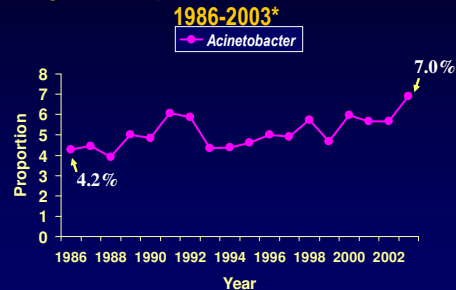


Finks J, et al. Emerg Infect Dis 2009;15:943-5.

Vancomycin-resistant *Enterococci* Among ICU Patients, 1995-2004



Proportion of Selected Gram Negative Organisms reported for PNEU, From ICUs 1986-2003*





Control & Prevention of CDI

- Hand Hygiene Drill Down Analysis:
 - Routine hand hygiene with an alcohol-based handrub before and after patient contact does **not** increase the risk of CDI during a non-outbreak period
 - Alcohol handrub has dramatically increased adherence with hand hygiene

Hand Hygiene on the Go
Use handrub only when no visible soil present

OR

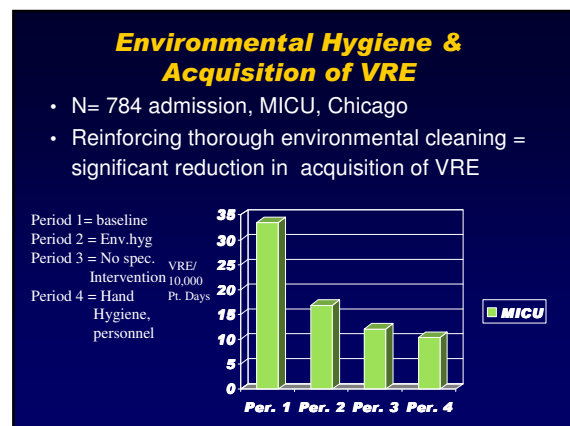
Wash In, Wash Out
7 Easy Steps to Saving a Life

Gerding DN, et al. Clin Infect Dis 2008;46:S43-9

Issues Related to Glove use

Gloves Can Prevent Contamination of Hands of HCWs – when used properly:

- Incidence of CDI dropped from 7.7 cases/1,000 patient discharges to 1.5 after intervention of consistent use of vinyl gloves by providers. [Johnson S. Am J Med 1990;88:137-40]
- Lack of use of gloves was associated with a cluster of CDAD & level of contamination of the environment correlated with frequency of hand contamination [Samore MH Am J Med. 1996;100:32-40]



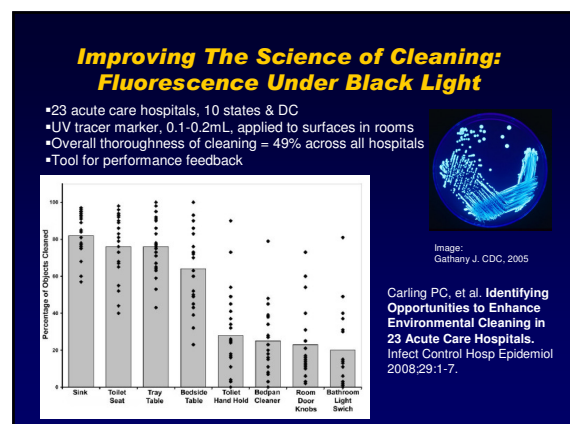
Patient Safety Using Hygiene

ORIGINAL INVESTIGATION
Effectiveness of Chlorhexidine Bathing to Reduce Catheter-Associated Bloodstream Infections in Medical Intensive Care Unit Patients

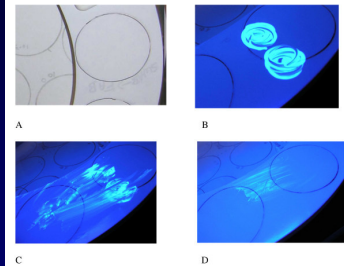
Source: Bleasdale SC, et al. Arch Intern Med 2007;167:2073-9

- 1 yr. cross over study in two MICUs, Stroger hospital, Chicago IL
 - Intervention: daily cleansing of patients with disposable cloth containing chlorhexidine gluconate (CHG)
 - Control group: daily cleansing with soap and water
- Results:
 - Intervention group:
 - 4.1 primary BSIs / 1,000 pt. days
 - 6.4 / 1,000 central line days
 - Control group:
 - 10.4 / 1,000 pt. Days
 - 16.8 / 1,000 central line days
- Conclusion: Incidence of BSI in CHG-cloth group was 61% lower than control (soap and water) group. Reduction of concentration of bacteria on skin lessens risk of BSI.

Bleasdale SC, et al. Arch Intern Med 2007;167:2073-9



Ultraviolet Marker on Environmental Surfaces



A = surface in visible light

B = Heavy residual marker

C = Moderate residual

D = Light residual

Source: Alfa MJ, et al. *BMC Infect Dis.* 2008; 8: 64

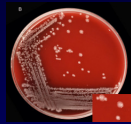
Contact Precautions (CP) & Patient Safety Paradox

- Quality of Care Case Control Study: adult patients on CP for MRSA; 2 large teaching hospitals, Boston & Toronto
- Care Process Results:
 - Vital signs incomplete or absent when on CP
 - More days with no RN or MD progress notes
- Outcomes & Satisfaction:
 - Freq. of adverse events 2x higher if on CP
 - Falls, pressure ulcers, fluid/electrolyte disorders = 8x higher among those on CP vs. controls
- Patient dissatisfaction: 17-38% on CP vs 3-5% for controls
 - Steffox HT, et al. *JAMA* 2003;290:1899-1905
 - See also: Saint S, et al. *Am J Infect Control* 2003;31: 354-6- attending MD 1/2 as likely to examine you if on CP



Is Active Surveillance Testing (AST) Needed? – Look Before you Leap

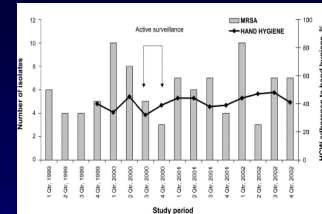
- Availability of private rooms
- Staffing needs: direct care & ICS
- Monitoring adherence with contact precautions by personnel
- Preventing unintended consequences of placing patients in contact precautions
- Decolonization therapy?
- Tracking of those positive for target MDROs & electronic alert system for subsequent readmissions?



Diekema DJ, Edmond MB. *Clin Infect Dis* 2007;44 (April 15)

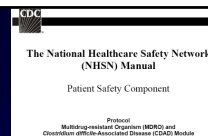
Is AST the Only Effective Intervention?

- Setting: Cook County Hospital, 600 beds; MICU [16 rooms; 12 private]
- ASC, N = 158 pts, 10 weeks
 - HA-colonization:
 - 55 (34.8% with MSSA)
 - 9 (5.7% with MRSA)
 - Colonized on admission:
 - 53 (33.5% MSSA)
 - 9 (5.7% MRSA)
 - No cross transmission & only 1 cluster of 2 cases of MSSA were found genetically unrelated



Nijssen S, et al. *Clin Infect Dis* 2005;40:405-9.

Measurement of MDROs



- Two options
 - Multi-drug resistant organism (MDRO)
 - C. difficile*-associated disease (CDAD)
- See also:
 - Cohen AL, et al. Recommendations for Metrics for Multidrug-Resistant Organisms in Healthcare Settings: SHEA/HICPAC Position Paper. *Infect Control Hosp Epidemiol* 2008;29(No.10):901-13.

http://www.cdc.gov/ncidod/dhqp/nhsn_MDRO_CDAD.html

CDC STRATEGIES: Management of Multidrug-Resistant Organisms In Healthcare Settings, 2006

Available at:
<http://www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf>

CDC MDRO Guide, 2006

• Tier 1. General Recommendations for Routine Prevention and Control of MDROs in Healthcare Settings:

- Make control & prevention of MDROs an institutional priority
 - Multidisciplinary process
 - Interfacility communication
 - Get involved in local, regional, and/or national collaboratives
 - Feedback trends and local resistance patterns to providers, clinical and administrative leadership

CDC MDRO Guide, 2006

• Tier 1. Continued:

- MDRO Education
- Judicious use of antimicrobials
- Decision support, order-entry systems
- Antimicrobial susceptibility trends
- Conduct surveillance
- Standard + Contact Precautions for target MDROs
- Environmental measures
- Decolonization – not recommended
- Tier 2 – if incidence or prevalence of target MDRO(s) is not decreasing or for outbreaks
 - ASC for populations at risk of MDROs
 - refer to 2006 Guide for additional details

Prevent Infection

1. Vaccinate
 - Influenza/pneumococcal vaccine to patients
 - Annual Influenza vaccine to HCW
2. Remove invasive devices as soon as possible
 - Use only when essential
 - Remove as soon as possible
 - Follow guidelines for insertion/care

Diagnose and Treat Infection Effectively

3. Target the pathogen
 - Culture the patient
 - Target empiric therapy to likely pathogen/local antibiogram
 - Target therapy to known pathogens and susceptibility results
4. Access the experts
 - Consult ID experts for serious infections

Use Antimicrobials Wisely

5. Practice antimicrobial control
 - Engage in local antimicrobial control efforts
6. Use local data
 - Know your antibiogram
 - Know your patient population
7. Treat infection, not contamination
 - Use proper technique for collection of cultures
 - Culture the blood, not skin or catheter hub
 - Use proper methods to obtain and process cultures

Summary Points on Control & Prevention of MDROs

- All Epidemiology is local: Based Prevention Strategies on Experience at your facility – check with your facility's Infection Preventionist
- Hygiene: Hands, Patients & the Environment.
- Keep your eye on the ball: prevent all HAIs – caused by resistant and susceptible microbes
- Use a systems-centered approach
- Involve direct care providers but get your organization's leadership on board
- Maintain Surveillance for MDROs and respond to clusters &/or disease outbreaks
- Place ASC in context of other HAI prevention initiatives at your facility